U.S. Department of Housing and Urban Development

Healthy Homes Issues: Injury

HEALTHY HOMES INITIATIVE (HHI) BACKGROUND INFORMATION
External Review Draft, Version 2
March 2002

Healthy Homes Issues: Injury

External Review Draft, Version 2
March 2002

Prepared for:

U.S. Department of Housing and Urban Development (HUD)
Office of Healthy Homes and Lead Hazard Control
Suite 3206
490 L'Enfant Plaza
Washington DC 20410

Prepared by:

Peter Ashley, Dr.P.H., U.S. Department of Housing and Urban Development (HUD)
John R. Menkedick, Battelle
Maureen A. Wooton, Battelle

March 2002

Contract No. C-OPC-21357

Acknowledgments

We thank the following individuals for their helpful comments and information used in preparation of this document.

Kevin Fearn, Senior Statistics Associate
Research and Statistics Department
National Safety Council
Itasca, IL

Murray L. Katcher, MD, PhD
Department of Pediatrics, Department of Family Medicine
University of Wisconsin Medical School
Madison, WI

Sarah J. Olson, MS, CHES
Julie Gilchrist, MD
Judy Stevens, PhD
Division of Unintentional Injury Prevention
Center for Injury Prevention and Control
Centers for Disease Control and Prevention.
Atlanta, GA

Ellen Taylor, M.S.
Emily Williams, M.S.
U.S. Department of Housing and Urban Development (HUD)
Office of Healthy Homes and Lead Hazard Control
Washington, DC

Preface

In October 1998, in response to Executive Order 13045 on "Protection of Children from Environmental Risks and Safety Risks", the U.S. Department of Housing and Urban Development (HUD) launched the Healthy Homes Initiative (HHI). The primary goal of the HHI is to protect children from housing conditions that are responsible for multiple diseases and injuries. As part of this initiative, HUD is preparing a series of papers to provide background information to their current HHI grantees, as well as other programs considering adopting a healthy homes approach. This background paper focuses on injury and provides a brief overview of the current status of knowledge on:

- The extent and nature of injury hazards in the home;
- Assessment methods for injury hazards in the home;
- Mitigation methods for injury hazards in the home; and
- Information needs in the field of residential injury research

Please address all questions and comments to:

Peter Ashley, DrPH
U.S. Department of Housing and Urban Development (HUD)
Office of Healthy Homes and Lead Hazard Control
Room P3206
451 7th Street, SW
Washington, D.C. 20410
Fax: 202 755-1000
Peter_J._Ashley@hud.gov

or

Maureen Wooton
Battelle
505 King Avenue
Columbus, Ohio 43201
Fax: 614 424-4890
wootonm@battelle.org

Table of Contents

List of Tables

List of Figures

Healthy Homes Issues: Injury

1.0 OVERVIEW OF THE PROBLEM

Compelling evidence exists that supports the significance of injuries, many of which are preventable, as a primary result of housing-related hazards:

- Unintentional injuries are among the leading causes of death. They are the fifth leading cause of death in the U.S. among individuals of all ages, exceeded only by heart disease, cancer, stroke, and pulmonary disease. Among individuals aged 1 to 34 years, injuries are the most common cause of death (CDC / WISQARS™, 1999).

- Of all unintentional injury deaths, injuries in the home are the second leading cause, only surpassed by motor vehicle related deaths. The National Safety Council estimates that in 1998, home-related injuries comprised about 29% of all injury-related deaths, amounting to approximately 28,800 deaths (NSC, 2001).

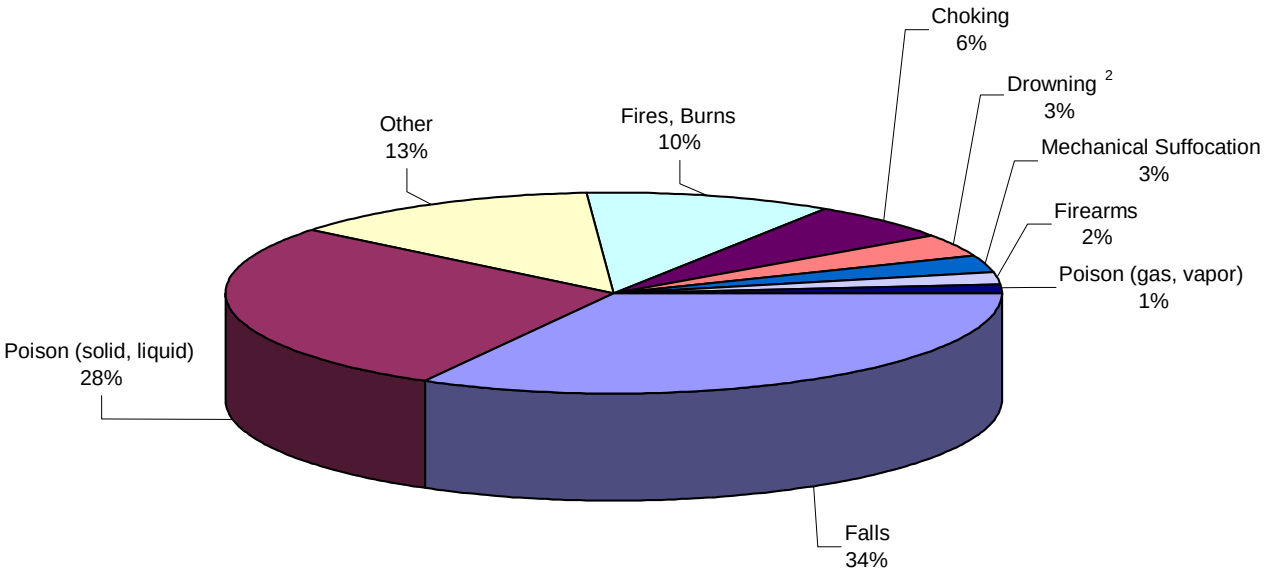
- Disabling injuries occur more frequently in the home than in the workplace and motor-vehicle related accidents combined. Injuries in the home were estimated to be responsible for 7.1 million disabling injuries in 2000 (NSC, 2001). According to the 1999 National Hospital Ambulatory Care Survey, over 29% of the 37.6 million emergency room visits because of injury in 1999 were as a result of injuries that occurred in the home (McCaig and Burt, 2001).

- The National Safety Council estimates that there is one death every 18 minutes and one injury every 4 seconds in the U.S. as a result of injury events in the home (NSC, 2001).

- Although quantification of both direct and indirect costs of injuries are difficult to develop, the National Safety Council estimates that the cost of home-related injuries, based on consideration of fatal and non-fatal injuries, medical costs, employer costs, wage and productivity losses, administrative expenses, and fire losses, totaled $111.9 billion in 2000 (NSC, 2001).

Although no sharp distinctions exist between injury and disease, injuries are usually perceived almost immediately after contact with the causal agent (Baker et al., 1992). Figure 1 shows the major categories of unintentional injury death in the home and the estimated relative magnitude of each in 1998.

Figure 1. Estimated Relative Magnitude [1] of the Major Categories of Unintentional Injury Death in the Home, All Ages Combined, 1998.



[Adapted from NSC, 2001. Source data: CDC, NCHS 1998 National Vital Statistics System Mortality data]
[1] Percent values reported in the figure are out of an estimated total of 28,800 home injury fatalities in 1998 (not including 200 deaths that occurred in motor vehicles at residences). These values are National Safety Council (NSC) 2001 revised estimates, which are based on analysis of 1998 injury data from the CDC's National Center for Health Statistics (NCHS). NSC analysis of NCHS data includes a disaggregation of home-related injuries from all other injuries using the "place of occurrence" code, or, when the "place of occurrence" code was missing, through the application of a 2-way split methodology (see NSC, 2001 Technical Appendix).
[2] NCHS 1998 National Vital Statistics System Mortality Data, compiled using the WONDER database (http://wonder.cdc.gov/) suggests that the NSC estimate for residential drowning may be low (see discussion below in Section 2.0 under "Drowning")

The most common causes of unintentional injuries and deaths in the home vary for different age groups. For example, for children aged 1 to 14 years, the second leading cause of injury-related death is drowning (only surpassed by motor vehicle accidents), while the primary cause of unintentional injury-related death for individuals over 65 years is falling (CDC / WISQARS™, 1999). Table 1 provides additional detail on the numbers of deaths due to unintentional injuries, by major category of injury and age group.

Figure 2 shows death rates, by age group, for unintentional injuries in the home. Although death rates for those over 75 are the highest, they also represent the smallest proportion of the population (NSC, 2001; CDC / WISQARS™, 1999; U.S. Census Bureau). Children are especially at risk for injuries because they are changing developmentally, they often exhibit risk-taking behavior, and they depend on adults for protection (Katcher).

Table 1. Estimated [1] Number of Deaths Due to Unintentional Injury in the Home, by Injury Type and Age Group, 1998.

Injury Type	Age group							
	0-4	5-14	15-24	25-44	45-64	65-74	75+	All Ages
Falls	50	30	40	340	940	1,300	6,800	9,500
Poisoning (solids or liquids) [2]	20	20	580	4,840	2,090	190	260	8,000
All other home [3]	100	40	40	480	740	680	1,720	3,800
Burns and deaths associated with fires	290	290	150	530	590	370	680	2,900
Choking (ingested object)	130	40	30	150	270	290	890	1,800
Drowning [4]	370	100	70	160	110	70	120	1,000
Suffocation (mechanical)	410	80	60	120	90	20	20	800
Firearms	20	90	180	180	80	20	30	600
Poisoning (gases)	10	10	50	100	90	60	80	400
All home [5]	**1,400**	**700**	**1,200**	**6,900**	**5,000**	**3,000**	**10,600**	**28,800** [5]

[Adapted from NSC, 2001 and NSC, 2002 (for age specific data). Source data: CDC, NCHS 1998 National Mortality Data]
[1] These values indicate National Safety Council (NSC) 2001 revised estimates based on analysis of 1998 injury data from the National Center for Health Statistics (NCHS). NSC analysis of NCHS data includes a disaggregation of home-related injuries from all other injuries using the "place of occurrence" code, or, when the "place of occurrence" code is missing, through the application of a 2-way split methodology (see NSC, 2001 Technical Appendix).
[2] Includes deaths from drugs, medicines, mushrooms, and shellfish, as well as commonly recognized poisons.
[3] Includes electrocution, burns from hot liquids and steam, and explosions
[4] NCHS 1998 National Mortality Data compiled using the WONDER database (http://wonder.cdc.gov/) suggests that the NSC estimate for residential drowning may be low (see discussion below in Section 2.0 under "Drowning")
[5] The total estimated number of residential injury fatalities in 1998 does not include 200 deaths that occurred in motor vehicles at residences.

The risk of injury has also been shown to vary substantially with race and economic status. For example, death rates for all types of unintentional injury combined are highest for Native Americans, relative to white, Black, and Asian ethnic groups (Baker et al., 1992 (analysis of data from 1980-1986); CDC / WISQARS™, 1999). From 1980 to 1986, the death rate from fires and burns for individuals with per capita income of less than $6,000 was approximately four times the death rate from fires and burns for individuals with per capita income of over $14,000 (Baker et al., 1992). Different types of injuries may also disproportionately affect certain minority populations (USDHHS, 1990). For example, death rates due to residential fire for African Americans or Native Americans are more than twice the rate for whites (CDC / WISQARS™, 1999). The risk of injury for young children may be linked to sociodemographic factors such as age and education of mother, with those of lower socioeconomic status typically being at greater risk of injury (Dowswell et al., 1996; Glik et al., 1993; Santer and Stocking, 1991; Dowd, 1999; Scholer et al., 1999). In 1997, Black children ages 0 to 14 were three times as likely to die in a house fire as white children (Katcher; USDHHS, 2000). In a seven-year study of childhood falls from windows, the incidence of falls in urban areas was four times that of surrounding non-urban areas, and Black children were three times more likely to fall than non-Black children (Stone et al., 2000).

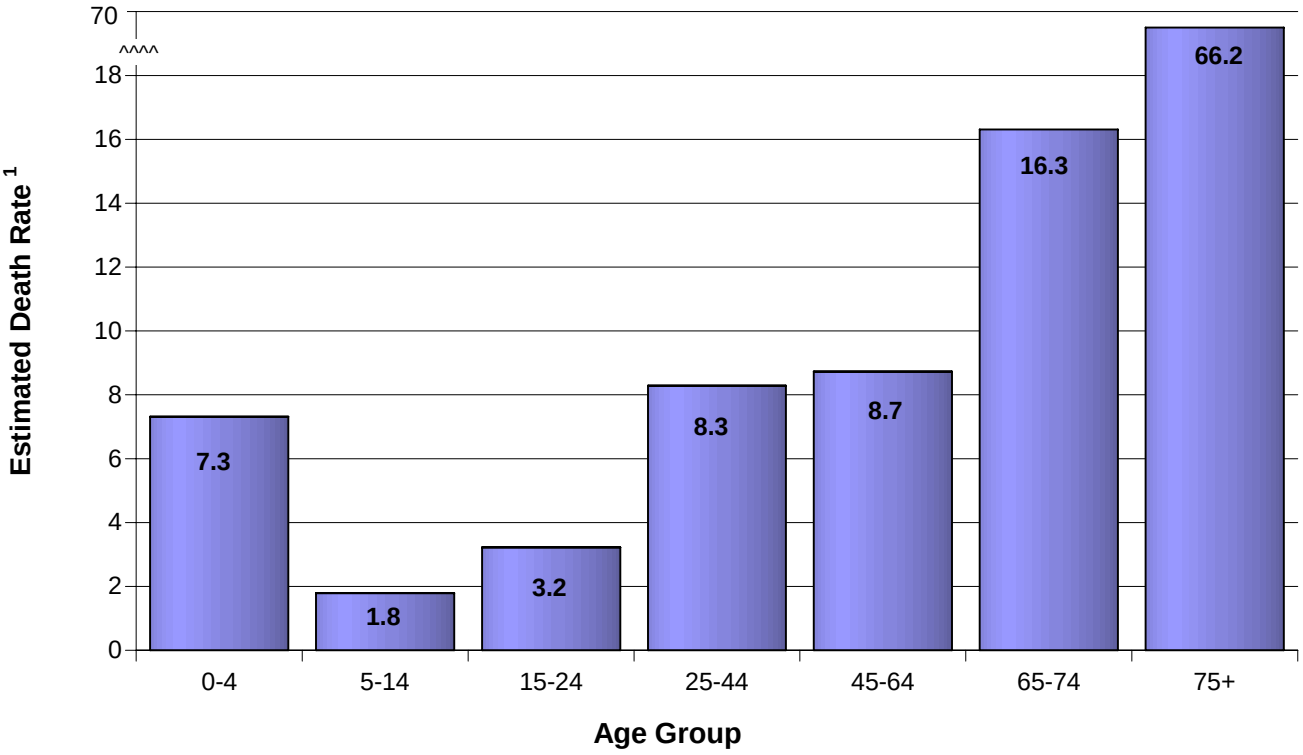


Figure 2. Estimated Death Rates[1] Due to All Home Injuries, By Age Group.

[1] Deaths per 100,000 population in each age group. Deaths rates were calculated as the estimated number of deaths (data source: the National Safety Council 1998 injury fatality estimates, as discussed in Figure 1 footnote 1), divided by the population estimate for a given age group (data source: the U.S. Census Bureau, postcensal estimates for 1998), multiplied by 100,000. [Death Rate = (deaths / population) * 100,000]

2.0 EXTENT AND NATURE OF RESIDENTIAL HAZARDS ASSOCIATED WITH INJURY

Generally, the linkages between hazard risk in the home and major housing-related injuries, including burns and other fire-related injuries, falls, suffocation, drowning, and poisoning are well established.

2.1 Falls

Falls are the most common cause of nonfatal injury, and the leading cause of injury mortality among older Americans. The NSC estimated that approximately 9,500 deaths due to falls in a residential setting occurred in 1998, with nearly 72 percent of these occurring in the over 75 age group and approximately 85 percent occurring in the over 65 age group (NSC, 2001, 2002). Nearly 60 percent of all residential injury deaths for those ages 65 and older are estimated to be due to falls (NSC, 2001, 2002). For adults 65 years old or older, it has been estimated that 60

percent of fatal falls happen at home (versus 30 percent in public places and 10 percent in health care institutions) (CDC, 2000a). By 2020, the cost of fall injuries for people age 65 and older is expected to reach $32.4 billion (Englander et al., 1996 as cited in CDC, 2000a). Although falls are an infrequent cause of death during childhood, falls are a major cause of nonfatal injury in children. Each year, more than 3 million children are treated in emergency departments for injuries from falls (CDC, 2000b). Falls for children are commonly associated with bicycles, playgrounds, trampolines, skateboards, in-line skates, and roller skates.

The residential hazards associated with falls are:

Adults 65+

- Lack of handrails on stairs,
- Lack of grab bars and non-slip surfaces in the bathroom, and
- Tripping hazards such as objects on the floor, lack of non-slip backing on rugs and other unsecured flooring.
- Behavior (e.g., lack of strengthening and coordination exercises in older adults).

Children

- Lack of safety gates to block stairways and other areas dangerous for children,
- Lack of window guards for windows accessible to children,
- Structural defects in the home (e.g., uneven floors),
- Insufficient lighting on stairs and in other areas,
- Use of unsafe infant walkers (i.e., those with translational motion), and
- Behavior (e.g., lack of supervision of children, not securely strapping children in high chairs, not moving cribs away from windows without screens, etc.).

2.2 Poisoning

In the context of residential injuries, discussion of poisonings in this paper is primarily focused on poisonings that would result in acute health effects. Discussion of lead poisoning, although not always acute in nature, is also included due to its importance in residential environments. Common causes of unintentional poisonings include medicines, drugs (including local anesthetics, barbiturates, narcotics, cocaine, and other unspecified drugs), carbon monoxide, cleaning products, solvents, plants, and agricultural pesticides and herbicides. Drugs, medicines, and biologicals accounted for 96 percent of 10,255 total deaths (all locations) by unintentional solid and liquid poisonings in 1998 (NSC, 2001). Exposure to medicines and toxic substances (solids and liquids) is common among the pediatric population, though the death rate due to this exposure is generally low (Dowd, 1999). The death rate for unintentional poisonings by solids and liquids is greatest for the 25 to 44-age range, most notably for males. The most common cause of poisoning by gases and vapors is carbon monoxide (CO) (NSC, 2001). Lead poisoning is an important concern that disproportionately affects children, nonwhites, and the poor (USEPA, 1998).

The primary residential hazards associated with unintentional poisonings are:

- Behavior (e.g., not locking up dangerous substances, improper use of products, not opening garage door when warming car, accidental or improper drug ingestion),
- Exposure to lead-based paint (e.g., dust from sanding lead-based paint, peeling paint chips),
- Lack of child-proof storage for toxic substances,
- Lack of proper ventilation and professional inspection and maintenance of furnaces, fireplaces, wood-burning stoves, and gas appliances, and
- Lack of carbon monoxide alarms.

Lead Based Paint. Despite dramatic reductions in blood-lead levels over the past 15 years, lead poisoning continues to be a significant health risk for young children. Based on results from the National Survey of Lead and Allergens in Housing (Clickner et al., 2001), it is estimated that approximately 40 percent of housing units (38 million) in the United States contain lead-based paint, and 18 percent of the nation's housing stock (17 million housing units) contains deteriorated lead based paint that can be considered a residential hazard for children. Recent results from CDC's Third National Health and Nutrition Examination Survey (NHANES III, Phase 2 and NHANES 1999) demonstrate that the national geometric mean blood-lead concentration of children aged 1-5 years has decreased from 2.7 to 2.0 μg/dL between the early and late 1990's (CDC, 2000c). However, analyses of data from 19 States participating in CDC's Childhood Blood-Lead Surveillance Program suggest that a high percentage (10.5% in 1996 and 7.6% in 1998) of children screened for lead poisoning are still being identified with elevated blood-lead levels above the threshold of 10 μg/dL (CDC, 2000c). Furthermore, recent analyses that examined the relationship between relatively low blood lead concentrations (<10 μg/dL) and cognitive functioning in a representative sample of U.S. children and adolescents, suggests that deficits in cognitive and academic skills associated with lead exposure may occur even at blood lead concentration lower than 5 μg/dL (Lanphear et al., 2000).

While children under the age of six historically have been considered at risk for lead poisoning, perhaps the greatest risk and most severe injury occurs in children under the age of two (USEPA, 1998). Many of the highest risk children live in older, deteriorating housing where routine maintenance and upkeep may have been deferred due to the financial constraints of the property owner. Current research shows that even subtle deterioration of largely intact lead-based paint on interior building components can create a significant hazard in household dust. This leaded dust is often accessible to young children through routes of ingestion based on normal activity patterns such as hand-to-mouth activities. Even moderate childhood lead poisoning can cause permanent injuries including cognitive impairments that are likely to affect development, educational potential, and subsequent ability to function as an adult (CDC, 1997). In addition, acute injuries to children have been well documented, most notably in instances involving sanding or stripping of lead-based paint or visible deterioration of lead-based painted residential building components combined with children who exhibit pica tendencies. Such instances can result in severe lead poisoning cases that require immediate medical intervention to prevent devastating health consequences, including seizures, coma, and death (CDC, 1997).

For example, the CDC recently documented a fatal pediatric lead poisoning case in New Hampshire, in which a two-year old girl died from lead encephalopathy after short-term (less than three weeks) exposure to extremely high levels of lead from dust and deteriorated paint in an older apartment being rented by the family (CDC, 2001a).

The U.S. Environmental Protection Agency has recently identified hazardous levels of lead in house dust. The dust-lead hazard standards, based on wipe sampling, are: 40 μg/ft2 for smooth or carpeted floors and 250 μg/ft2 for interior window sills (USEPA, 2001). The standards should be compared to a surface-specific weighted average of the dust wipes (i.e., determined separately for floors and window sills). The EPA regulation also established hazard levels for bare residential soil. In play areas, lead-contaminated soil is defined as soil with a lead concentration of 400 parts per million (ppm) or greater. In the rest of the yard the hazard level is defined as an average soil-lead level of 1,200 ppm or greater in bare soil.

Carbon Monoxide and Other Indoor Air Toxics. In indoor environments, potentially toxic substances may be present as airborne gases or particulates. These substances include nitrogen oxides, sulfur oxides, carbon monoxide (CO), radon, environmental tobacco smoke (secondhand smoke or ETS), formaldehyde, and volatile organic compounds (VOCs). Carbon monoxide poisoning is the most common cause of acute poisoning by inhaled gases in residential situations (NSC, 2000). For most of the other indoor air pollutants, the majority of concern with typical exposures centers on long-term risk for disease. However, more immediate injury-like effects, such as respiratory distress, asthma exacerbation or developmental or neurotoxic effects (especially in sensitive individuals or those who incur high exposures), have also been linked to chemical exposures in indoor environments (Becher et al., 1996; Garrett et al., 1998).

In the home, major sources of CO (as well as other combustion products such as nitrogen and sulfur oxides, VOCs, and particulates) include tobacco smoke, vehicle start-up and idling in attached garages, and combustion appliances that are either unvented or that have improperly installed or malfunctioning ventilation. The major combustion appliances associated with CO poisonings are unvented appliances, such as gas or kerosene appliances for cooking or heating (e.g., space heaters) and fireplaces. Because unvented gas cooking ranges/ovens are used intermittently for cooking purposes, it is not likely their use would result in substantial increases in CO over long periods of time, except possibly in households where gas ovens are used improperly as a primary or secondary source of heat (USEPA, 2000). Other unvented sources can also be a hazard when being used improperly, such as charcoal grills, hibachis or gasoline-powered engines or tools when being used in an enclosed environment. Carbon monoxide in the indoor environment from vented combustion appliances (furnaces, hot water heaters, and gas clothes dryers) is generally negligible unless the unit is malfunctioning (USEPA, 2000).

2.3 Burns and Fire-Related Injuries

Roughly eight out of ten fire deaths in the U.S. occur in the home (Hall, 1997). Smoke inhalation accounts for the largest percent of home fire injuries overall; about half of all victims

are asleep when the fire occurs (Hall, 1997). Relative to the entire population, death rates due to fire are highest among children ages 0 to 4 and individuals over age 75 (NSC, 2000). Young children and the elderly may have difficulty escaping from burning buildings, even in cases where a smoke alarm may be sounding. Death rates relative to the entire population are also higher for certain minority populations. For example, African Americans and Native Americans die at more than twice the rate of whites from residential fires (USDHHS, 2000). The higher rates of injury deaths caused by fires for minorities likely reflect the higher overall rates of home-related injuries associated with poverty or lower levels of education (e.g., due to type and condition of housing, substandard housing and lack of building code enforcement) (Schwarz et al., 1993; Katcher; USDHHS, 1990).

The largest cause of residential fires resulting in death is cigarettes and other lighted tobacco products; however, the leading causes of all residential fires are cooking and heating equipment (e.g., portable heaters), electrical distribution systems, and children playing with matches or lighters (Ahrens, NFPA, 2001). Lack of a working smoke alarm, living in manufactured (mobile) homes (particularly those built before 1976 when building codes changed (Runyan et al., 1992), and impairment by alcohol or drugs also increase the likelihood of death in cases of residential fire (Marshall et al., 1998; Runyan et al., 1992). Alcohol is involved in approximately 40 percent of deaths associated with residential fires (Runyan et al., 1992).

Burns also commonly occur from contact with hot liquids (scalds), objects, or electricity. In 1997, an estimated 12,400 scald burns were sustained by children, nearly a quarter of which were caused by hot tap water (Schieber et al., 2000). Most scald burns occur as a result of contact with hot food and drink or tap water. Burns as a result of scalding by hot tap water are generally more severe than other scalds, and occur most frequently in the bathtub or shower, but may also occur in the kitchen or bathroom sink. Most victims of scald burns from tap water are younger than 5 years, although other high-risk groups include the elderly and those with physical or mental disabilities. These three risk groups account for almost 90% of those burned by hot tap water (Katcher).

The primary residential hazards associated with burns and fire-related injuries are:

- Lack of functional smoke alarms near or inside bedrooms and on every floor of the house,
- Lack of fire extinguishers,
- Lack of anti-scald devices for shower heads and faucets,
- Lack of safety plug covers to prevent electric burns, and
- Behavior (e.g., water heater thermostats set above 120°F; smoking inside the home; not establishing and practicing fire escape routes and procedures; not preventing children's access to matches and lighters; storing flammable liquids under unsafe conditions; not turning pot handles to back of the stove and leaving hot foods and liquids near the edges of tables or counters; and not testing bath water).

2.4 Electrocution

The primary residential hazards associated with electrocution include:

- Lack of safety plugs to cover electrical outlets,
- Lack of ground fault circuit interrupters in bathrooms, kitchens, and other rooms with water or dampness,
- Lack of professional inspection of wiring, especially in older homes, and
- Behavior (e.g., not keeping electrical appliances out of the reach of children and away from water).

2.5 Choking

Choking includes injury or deaths from unintentional ingestion or inhalation of objects or food resulting in the internal obstruction of the respiratory passages. Death rates due to choking are highest for individuals older than age 75 (890 deaths in 1998), followed by the 0 to 4 age group (140 deaths in 1999) (NSC, 2000). Foods that most commonly cause choking deaths are hot dogs and other chunks of meat, grapes, apples, nuts, popcorn, watermelon seeds, raw carrots, and candy. Objects that are commonly choked on by children are parts of toys, batteries, coins, jewelry, office supplies, balloons, rubber balls, and marbles.

The primary residential hazards associated with choking are:

- Behavior (e.g., not keeping common choking objects away from children, not serving appropriate sized food to young children and the elderly),
- Lack of education for the elderly on common causes of choking, and
- Lack of training in the Heimlich maneuver and CPR.

2.6 Drowning

The NSC estimated that in 1998, approximately 1000 drowning deaths (across all ages) occurred in or on home premises, with drowning death being defined as death within 24 hours after an immersion event. Drowning is the second leading cause of injury death among children aged 1-14, surpassed only by motor vehicle accidents (CDC / WISQARS™, 1999; NSC, 2001, 2002). However, NCHS 1998 National Mortality Data compiled using the "Wide-ranging Online Data for Epidemiological Research" (WONDER) database (http://wonder.cdc.gov/) suggests that the NSC estimate for residential drowning may be low. Although the NCHS WONDER database groups together injuries regardless of place of injury occurrence, a query based on the injury codes for "drowning in the bathtub" (E-code 910.4) and "other drowning" (E-code 910.8) (which is believed to primarily consist of drowning in residential swimming pools, but may also include drowning in industrial quenching tanks or other unspecified drownings), indicated that the number of residential drowning deaths in 1998 may have approached 2,600. Regardless of exact numbers, all estimates support the conclusion that residential drowning hazards, particularly in children under 14, are of serious concern.

The places and ways in which children drown are related to the developmental stage of the child. Infants often drown in bathtubs or other fluid filled containers such as 5-gallon buckets (Katcher). According to U.S. Consumer Product Safety Commission (CPSC) estimates in 1994, an estimated 50 deaths and 130 emergency room visits are related to bucket drowning each year (NSC, 1994). For every drowning death, roughly four significant non-fatal submersion injuries occur (Katcher; Baker et al., 1992). According to the CPSC (see CDC, 2000a, "Drowning Prevention" factsheet), most small children (younger than 5 years old) drown in swimming pools, with between 60 and 90 percent of drownings among children estimated to occur in residential swimming pools. They also estimate that about 60 percent fewer drownings occur in swimming pools (in ground) with four-sided isolation fencing, compared with pools without four-sided fencing.

The primary residential hazards associated with drowning are:

- Access to 5-gallon buckets for children,
- Behavior (e.g., lack of supervision of young children in the bathroom or around water),
- Lack of childproof fencing around residential swimming pools, and
- Lack of training in CPR.

2.7 Suffocation and Strangulation

Mechanical suffocation includes injury or death resulting from external smothering by bedding, thin plastic materials, or confinement in closed spaces. Mechanical strangulation is also an external event that most commonly occurs from cribs with slats spaced greater than 2-3/8 inches, mattresses that are not fit well for crib size, drawstrings, and dangling cords from window blinds (Katcher; Baker et al., 1992). Death rates due to mechanical suffocation and strangulation are highest for children aged 0 to 4 years, at 300 deaths in 1999 (NSC, 2000).

The primary residential hazards associated with suffocation and strangulation are:

- Lack of a safe sleep environment for children,
- Lack of safety lids on storage chests,
- Behavior (e.g., not tying up window blind cords, not keeping plastic bags away from children, lack of supervision of children), and
- Lack of CPR training.

2.8 Firearms

Unintentional deaths due to firearm injuries in the home totaled 600 in 1998 (NSC, 2001). It is estimated that 2.6 serious nonfatal firearm injuries occur for every death from firearms (Annest et al, 1995 as cited in Dowd, 1999). The 15-24 year old age group has the highest death rate for home firearm injuries (NSC, 2000). Surveys of various sociodemographic groups have shown that guns are readily available to children and adolescents. For example, 42 percent of seventh and tenth graders surveyed in Boston and Milwaukee reported having easy access to guns and 17 percent admitted to carrying a concealed weapon (Bergstein et al., 1996 as cited in Dowd, 1999).

In addition, children are often permitted to play with air guns (BB and pellet guns), despite the fact that they can inflict injury and death (Dowd, 1999). Bhattacharyya et al. (1998, as cited in Dowd, 1999) studied air gun-related injuries over a period of several years at one hospital and found that half of 42 patients admitted for air-gun related injuries required surgical intervention and 16 had a long-term disability as a result of their injury.

3.0 METHODS USED TO ASSESS AND MITIGATE THE HAZARDS ASSOCIATED WITH INJURY

Injuries, like disease, are predictable from epidemiological data (i.e., examination of a host, agent, and environmental risk factors) and are preventable (Katcher; USDHHS, 1990). Measures to control injury may be active (e.g. supervision of a child), or passive (e.g., changing the environment), and may require single or repetitive actions (Katcher). Modifying man-made systems or products is often more feasible than altering individual behavior (Baker et al., 1992). Katcher, in a preliminary Healthy Homes Initiative Report on Unintentional Injury, cites the most effective prevention strategies as involving the provision of passive protection through a single one-time action (such as turning down the water heater thermostat to prevent tap water scalds). Important components of an injury prevention program include:

- Injury surveillance and reporting,
- Public and individual education and outreach,
- Making safety devices available and encouraging their use,
- Technological improvements to reduce hazards, and
- Legislation and regulation, including enforcement of hazard reduction laws.

Laws and legislation are among the most effective mechanisms for adopting safety behaviors for large segments of the population (Schieber et al., 2000). For example, mortality of children younger than five years from unintentional poisoning by oral prescription drugs decreased abruptly when the Poison Prevention Packaging Act first became effective in 1972, then decreased an additional 45 percent between 1974 and 1992 (Schieber et al., 2000). However, the legislative process can be slow, regulations can be denied, and enforcement can be difficult.

Education of parents has been shown to be effective on the individual level in a variety of clinical settings such as physicians' offices, clinics, emergency departments, or hospitals (DiGuiseppi and Roberts, 2000). However, only a relatively small proportion of households with young children report receiving such counseling (Quinlan et al., 1998). Doctors are well situated to offer advice on home safety as well as options for low-income families to obtain safety features such as stair gates and electrical outlet plugs (Lowry, 1990). Pediatricians may also have a greater impact in promoting home safety by gaining the support of a wider community (e.g., local health departments) to make injury prevention a priority (Gallagher et al., 1985).

Some research also suggests that, certain injury prevention programs may require supplemental education in a home setting. For example, DiGuiseppi and Roberts (2000) reviewed studies evaluating the effects of educational interventions in a clinical setting to counsel families on childproofing their homes. Overall, evidence suggested that clinical counseling had little effect on most home safety practices designed to childproof the home (DiGuiseppi and Roberts, 2000). Gallagher et al. (1985) successfully demonstrated a reduction in household hazards by combining safety counseling and the installation of safety devices with normal housing code enforcement. Home visitation, including resident education, is generally cited as an effective means to assess and address multiple injuries hazards in the home (Cohen et al., 1996 as cited in Katcher). Home visitation programs may reduce injury risk through initial home hazard inspections, customized interventions and resident education, and follow-up hazard inspections. Home visits for injury could be combined with other interventions (e.g., public health nurse visits, weatherization visits, etc.).

Table 2 provides an overview of selected major actions and strategies, as well as their effectiveness and estimated cost, for reducing risks for specific injury categories. Table 2 is presented as an initial draft to frame information needs related to cost and effectiveness of major injury intervention methods.

3.1 Falls

A number of measures can be taken to prevent residential injuries caused by falls. Safety devices such as grab bars and non-slip surfaces can be installed in bathrooms. To protect children, safety gates can be used to block stairs and dangerous areas, and window guards can prevent children from falling out of windows that do not have screens. Some measures involve modifying behavior or home structure. For the elderly, these include repairing unsafe stairs or other structural defects, improving strength/balance/flexibility through exercise, reviewing medications which could disrupt balance, wearing low-heeled non-slip sole shoes, and improving vision (e.g., through glasses or increased lighting). For parents, these include supervising children, child-proofing homes, and repairing structural defects.

3.2 Poisoning

Mitigation methods vary for different types of unintentional poisonings in the home. For poisonings by solids and liquids, preventive measures include mitigating lead hazards, installing safety locks on cabinets, locking up medicines and dangerous substances, buying less toxic consumer products, taking medicines as prescribed. The most common methods of preventing poisonings by gases and vapors are professional inspection and maintenance of gas and wood burning appliances, the correction of improper ventilation systems for these appliances, installation of carbon monoxide alarms, and education on hazardous behaviors, such as warming a vehicle in an attached garage.

Table 2. Selected Major Injury Prevention Methods, Grouped by Cause of Injury

Category	Effectiveness Assessment	Estimated Cost [1]
Falls		
Safety devices in bathrooms (e.g. grab bars, non slip surfaces)	Assumed [2]	Low/Medium
Safety gates to block dangerous areas	Assumed [2]	Low
Window guards	Assumed [2]	Medium
Repair of structural defects (e.g., unsafe stairs)	Assumed [2]	Medium/High
Education & behavior modification (e.g., supervising children, child-proofing homes, exercises to improve strength/balance/flexibility, review of medications)	Unknown	Low
Poisoning		
Carbon monoxide alarms	Unknown [3, 4]	Low/Medium
Correction of improper ventilation systems for gas and wood burning appliances	Assumed [2]	High
Inspection of gas burning appliances	Assumed [2]	Low
Lead hazard mitigation (e.g., addressing peeling paint, conducting specialized cleaning for lead dust, covering bare soil in yards, proper painting and renovation work practices)	Studied [5], quantified as effective	Medium to High
Safety locks for cabinets and other secure storage	Assumed [2]	Low
Education & behavior modification (e.g., buying less toxic consumer products, not warming car in an attached garage, locking up dangerous substances)	Unknown	Low
Deaths Associated with Fire and Non-Fire Burns		
Smoke alarms	Studied [4], quantified as effective	Low
Fire extinguishers	Assumed [2]	Low/Medium
Home sprinklers	Studied [4], quantified as effective	High
Anti-scald devices for showers and sinks	Assumed [2]	Low
Safety covers for outlets	Assumed [2]	Low
Ground circuit interrupters	Assumed [2]	Low/Medium
Education & behavior modification (e.g., setting water heater thermostats low, not smoking in home, using childproof lighters, wearing flame retardant sleepwear, practicing fire escape routes, placing space heaters way from flammable materials)	Unknown	Low
Choking		
Education & behavior modification (keeping dangerous objects away from children, Heimlich maneuver and CPR training, education on size of toy parts and food)	Unknown	Low
Drowning		
Education & behavior modification (e.g., supervising young children around water, training in water survival, safely storing 5 gallon buckets, CPR training)	Unknown	Low
Fencing around pools and hot tubs	Studied [4], quantified as effective	Medium
Suffocation and Strangulation		
Storage chest safety lids	Assumed [2]	Low
Safe sleep environments for children (e.g., cribs with slats less than 2 3/8 in. apart, well-fitting mattresses)	Assumed [2]	Medium
Education & behavior modification (e.g., tying up window cords, keeping plastic bags away from children, CPR training)	Unknown	Low
Firearms		
Education & behavior (e.g., remove guns from children's environment, store guns unloaded and lock up ammunition separately)	Unknown	Low
Trigger locks	Unknown	Low

[1] Estimated cost, for the purposes of this report, are categorized as follows: high = more than $500; medium = $50–500, low = less than $50. [2] No data were identified at the time of this report preparation. [3] Research on the performance of CO alarms is ongoing. The Consumer Products Safety Commission (CPSC) currently considers CO alarms that meet UL 2034 or IAS 6-96 standards as important as smoke alarms in home safety. [4] See discussions below. [5] See Galke et al., 2001; USEPA, 1998b.

Carbon Monoxide Alarms. Along with regular inspection of combustion appliances, properly working CO alarms can provide home occupants with an early warning before indoor CO levels reach dangerous levels. The Consumer Product Safety Commission (CPSC) believes that CO alarms are as important to home safety as smoke alarms, and recommends that homes have at least one carbon monoxide alarm that conforms to the most recent Underwriters Laboratories standard (UL 2034) or the International Approval Services Standard 6-96 on each sleeping floor (preferably every floor), with an additional alarm in the area of any major gas burning appliances. Although previous research has suggested that CO alarms sometimes fail to perform reliably (Clifford and Siu, 1998), alarm improvements have since been implemented in response to a 1997 revision to the UL 2034 design standard (which was effective for alarms manufactured after October 1998), and a June 1998 revision to the IAS No. 6-96 supplemental standard (which sets forth a uniform reliability requirement for CO alarms considering their manufacturing quality and lifetime failure rates). Research on the performance of CO alarms, including the long-term performance of alarms under field conditions, is ongoing. CPSC currently considers any alarm that conforms to the UL 2034 or IAS 6-96 standards acceptable for added protection against CO poisoning in the home, to be used in conjunction with proper use and upkeep of appliances that can produce CO.

3.3 Burns and Fire-Related Injuries

Many devices can be used to prevent burns and deaths associated with fire. These include: smoke alarms, fire extinguishers, home sprinklers, escape ladders, anti-scald devices for showers and sinks, safety covers for outlets, and ground circuit interrupters. Other prevention strategies require altering individual behavior, for example: not leaving children unsupervised, not smoking in the home, using childproof lighters, wearing flame retardant sleepwear, practicing fire escape routes, placing space heaters away from flammable materials, and setting water heater thermostats low.

Smoke Alarms. The presence of a functioning smoke alarm has proven to be effective in reducing mortality from residential fires (Dowd, 1999). According to the National Fire Protection Association (as cited in NSC, 2000), homes with smoke alarms usually have a death rate from fires that is 45 to 50% lower than the rate for homes that have no alarms. In one- and two-family dwellings, only 16% of fire deaths during 1988-1997 resulted from fires where a smoke alarm sounded, although 39% of apartment fire deaths occurred under these conditions.

According to the U.S. Consumer Product Safety Commission (as cited in NSC, 2000), of the homes containing at least one smoke alarm, one of every five had no functioning alarm. The CPSC also found that 25% of all U.S. households had no smoke alarms or only non-functioning smoke alarms. Causes for non-functioning smoke alarms include: a disconnected power source, a dead or missing battery, improper installation, or improper placement of the alarm. One of the largest reasons for disconnected or missing power sources in alarms is the frequency of nuisance alarms (NSC, 2000). Smoke alarms should be tested monthly and batteries replaced twice a year (Dowd, 1999).

The effectiveness of smoke alarms is also influenced by their number and placement in the home. At least one smoke alarm should be installed on every floor of the home, including the basement, and outside each sleeping area. Because smoke rises, alarms should be mounted high on walls or ceilings, away from windows, doors, or forced-air registers where drafts could interfere with their operation. The direct distribution of smoke alarms to homes has been found to be more effective and cost efficient in reducing deaths due to residential fires than other public education methods such as distributing brochures about smoke alarm giveaways (Douglas et al., 1998 as cited in Dowd, 1999). However, research also indicates that poor maintenance can often limit these programs in the longer-term, and therefore, giveaway programs are more effective when followed by maintenance and inspection programs, especially in certain high-risk areas (Warda et al., 1999). A study in Baltimore demonstrated that 92 percent of households receiving free smoke alarms (upon request) had installed them (as cited in Gallagher et al., 1985). A project in Oklahoma City showed that the distribution of smoke alarms, combined with large-scale education, was effective in reducing injuries and deaths due to residential fires. Over a four-year period, the annualized fire-injury rate per 100,000 population in the target area declined by 80 percent while the rate in the rest of the city rose by 8 percent. Similarly, the injury rate per 100 residential fires declined 74 percent in the target area and increased 32 percent in the rest of Oklahoma City (Mallonee et al., 1996). Distribution of hard-wired or long-lasting (10-year) lithium battery-powered smoke alarms may also help to make smoke alarm giveaways more effective in the long term.

Fire Extinguishers. Fire extinguishers can be used to put out small fires in the home. However, extinguishers must be checked periodically to ensure they are properly charged, and occupants must be trained on how to use a fire extinguisher effectively. Only adults should handle fire extinguishers. Most importantly, residents should understand that most portable extinguishers empty in 8 to 10 seconds and that they should evacuate if the fire is not extinguished immediately.

Home Sprinklers. Home fire sprinklers are often overlooked as an effective strategy for preventing deaths in house fires. Conley and Fahy (1994) estimate that the chances of dying in a fire when sprinklers are present may be one- to two-thirds lower than the chances of dying in a fire in which sprinklers are not present. Kay and Baker (2000) estimate that while smoke alarms can reduce the fire death rate by 50%, sprinklers alone can reduce deaths by about 70%, and the combination by 80%. Fire sprinklers can effectively extinguish residential fires and save lives without human action. This protection is especially beneficial for those who cannot escape easily without help, such as children, the elderly, the disabled, or intoxicated persons.

The use of fire sprinkler technology as a prevention strategy may be diminished by misconceptions about fire sprinklers activating accidentally and causing extensive water damage. In practice, automatic sprinklers rarely go off by mistake, and each sprinkler head is independently activated by the heat of a fire as needed so that only sprinklers in the immediate area of flames will activate. With water discharge rates less than 30 gallons per minute, home sprinklers in fact reduce property loss as compared to damage caused by fire hoses discharging over 300 gallons per minute. Misconceptions about the cost of home sprinklers may be another deterrent to their installation in new homes and housing units. Installation costs have been

reduced through the use of plastic pipe to $1.00-$1.50 per square foot of finished floor space in new housing, about the same cost as installing carpet or upgrading cabinets. In addition, the cost of installation can be recovered by significant reductions in insurance premiums.

Fire and Burn Education. Programs funded by the National Fire Protection Association and public fire departments help save lives by teaching the public how to prevent fires and how to react during fires. Fire prevention education includes lessons on potential home fire hazards (e.g., smoking in bed, poorly maintained furnaces and chimneys), how to "stop, drop, and roll," the use and maintenance of smoke alarms, the danger in leaving children unattended, keeping matches and lighters away from children, and developing a family escape plan that includes multiple escape routes with unblocked exits or quick-release devices (for bars and locks), fire drills, and a designated safe meeting place outside.

Thermostats in Water Heaters. As of the late 1980s, water heater manufacturers have voluntarily agreed to preset all electric water-heater thermometers to 120°F (Dowd, 1999). However, because thermostats in water heaters can sometimes be inaccurate (especially in the case of older water heaters), parents are advised to measure hot water temperatures using a thermometer, and if necessary, lower the temperature so that it does not exceed 125°F to 130°F, where the likelihood of scald injury increases (Dowd, 1999; Schieber et al., 2000). Education regarding hot water temperature (especially with the provision of a free thermometer) has been shown to result in more than a twofold increase in the likelihood of lowering hot tap water temperature (DiGuiseppi and Roberts, 2000). However, residents of apartments may not have access to or control of their hot water settings (Doc4Kids Project, 1998).

3.4 Choking

Methods to prevent choking include keeping dangerous objects away from children and education on the Heimlich maneuver and CPR, the appropriate size of toy parts for small children and the appropriate size of food for small children and the elderly. Under the Child Safety Protection Act (CSPA) (effective January 1, 1995), any ball with a diameter of 1.75 inches (44.4mm) or less is banned in products that are manufactured in or imported into the United States for use by children younger than 3 years of age. For children three years or older, labeling of toys with small parts is required to indicate a potential choking hazard. The CDC generally suggests that any toy that is small enough to fit through a 1 ¼-inch circle or is smaller than 2 ¼ inches long is unsafe for children under 4 years old. Additional information on preventing choking among children is available at www.cpsc.gov and www.cdc.gov/safeusa/home/choke.htm.

3.5 Drowning

According to the U.S. Consumer Product Safety Commission, 60% fewer drownings occur in in-ground pools with four-sided isolation fencing as in-ground pools without four-sided fencing (CDC, 2000a). Childproof fencing 4.5 to 5 feet high is recommended around swimming pools (Wintemute, 1990 as cited in Baker et al., 1992). The use of pool covers in some cases is believed to have contributed to drownings. Training in cardiopulmonary resuscitation (CPR) is strongly recommended for owners of swimming pools (Baker et al., 1992). Teaching older

children to swim has also been associated with reduced risk of drowning (Dowswell et al., 1996), though swimming instruction in young children may lead to overconfidence in swimming ability, as can air-filled swimming aids such as "water wings" (CDC, 2000a).

A study of low-income urban families found that 89 percent of children aged 35 to 59 months and 6 percent of those younger than 3 years old sometimes bathed without adult supervision (Santer and Stocking, 1991). Prevention of drownings and near-drownings requires education concerning the importance of supervising children, particularly during bathing and while five-gallon buckets are in use. CPSC offers three free publications consumers can use to help prevent child drowning: "Safety Barrier Guidelines for Pools," "How to Plan for the Unexpected" and "Guidelines for Entrapment Hazards: Making Pools and Spas Safer." Copies of these publications can be obtained at CPSC's website at www.cpsc.gov.

3.6 Suffocation and Strangulation

Prevention of suffocation and strangulation requires safe sleep and play environments for children. Cribs slats should be less than $2\ ^{3/8}$ inches apart, mattresses and sheets should be well-fitting, storage and toy chests should have safety lids, and window cords should be tied up and plastic bags kept out of reach of children. CPR training for parents and caregivers can also help reduce death by suffocation and strangulation.

3.7 Firearms

The American Academy of Pediatrics recommends removing guns from environments where children live and play as the best method of prevention of firearm injuries. Where this is not possible, it recommends that guns be stored unloaded and ammunition be locked and stored separately (Dowd, 1999). The American Academy of Pediatrics also is involved in a firearm injury prevention training project designed to provide pediatricians with the skills and resources necessary to reduce firearms injuries and deaths. Child access prevention laws are currently in place in 16 states, and one state has passed a law regarding trigger locks, which are devices that can be purchased at a minimal cost and installed while a gun is in storage to prevent unauthorized use or accidental firing of that gun (Schieber et al., 2000). Child access prevention laws hold the owner of an unsecured gun responsible for injuries inflicted with that gun as a result of a child gaining access to the gun.

4.0 CURRENT RESEARCH NEEDS AND INFORMATION GAPS

Possible areas of consideration for future research include:

- Data on the effectiveness (and the duration of benefit) of community-based injury prevention strategies.

- Further data on the effectiveness of clinic- and home-based education programs, as well as public education campaigns. For example, is one strategy more effective than

another? Are two in combination more effective? Does focusing on a single injury produce the most successful outcome, or can multiple injuries be addressed at once?

- Costs and benefits of reducing residential injury hazards.

- Identification and characterization of residential injury risk factors for different types of injuries.

- Better understanding of parental knowledge and practices and how they relate to childhood injury.

- Strategies to educate landlords, parents, and policy makers about the need for window guards, working smoke alarms, and locked storage space for hazardous substances, particularly in multiple-unit dwellings and public housing projects.

- Assessment of the potential for effective use of insurance benefits and penalties for not having a working smoke alarm in a rental property

- Evaluation of the effectiveness of swimming instruction and risk-taking behavior among youth related to drowning injuries and death.

- The effectiveness of various types of exercise in preventing falls among the elderly.

- Assessment of the effectiveness of regulatory interventions in preventing firearm-related injuries and deaths (e.g., childproofing, magazine safeties and trigger locks, personalization, loaded-chamber indicators).

- Research on methods to increase residential smoke alarm installation purchase, installation, use and routine maintenance among high risk groups.

- Research on interventions to reduce childhood poisoning in and around the home.

References

Ahrens, M. 2001. U.S. Fire Problems Overview Report: Leading Causes and Other Patterns and Trends. National Fire Protection Association (NFPA) International. Quincy, MA.

Annest, J.L., Mercy, J.A., Gibson, D.R., and Ryan, G.W. 1995. National estimates of nonfatal firearm-related injuries: beyond the tip of the iceberg. J American Medical Association. 273: 1749-1754.

Baker S.P., O'Neill B., Ginsburg M.J., and G. Li. 1992. The Injury Fact Book, Second Edition. Oxford University Press, USA. 368 pp.

Bhattacharyya, N., Bethel, C., Caniano, D., Pillai, S., Deppe, S., and Cooney, D. 1998. The childhood air gun: serious injuries and surgical interventions. Pediatric Emergency Care. 14: 188-190.

Becher, R., Hongslo, J.K., Jantunen, M.J., and E. Dybing. 1996. Environmental chemicals relevant for respiratory hypersensitivity: the indoor environment. Toxicology Letters. 86: 155-162.

Bergstein, J.M., Hemenway, K., Kennedy, B., Quaday, S., and Ander, R. 1996. Guns in young hands: a survey of urban teenager's attitudes and behavior relating to handgun violence. J. Trauma. 41: 794-798.

CDC / WISQARS™. Web-based Injury Statistics Query and Reporting System (WISQARS ™), various years. Office of Statistics and Programming, National Center for Injury Prevention and Control (NCIPC), Centers for Disease Control and Prevention. Data sources: National Center for Health Statistics (NCHS) National Vital Statistics System for numbers of deaths, U.S. Census Bureau for population estimates. http://www.cdc.gov/ncipc/wisqars/

CDC. NCHS Vital Statistics System / National Mortality Data, 1998. Statistics compiled using WONDER (Wide-ranging Online Data for Epidemiological Research) at http://wonder.cdc.gov/. Data sources: National Center for Health Statistics (NCHS) National Vital Statistics System for numbers of deaths, U.S. Census Bureau for population estimates.

CDC. 2001a. Fatal Pediatric Lead Poisoning – New Hampshire, 2000. Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report. 50(22): 1133-7.

CDC. 2000a. Online Factsheets: *Falls and Hip Fractures Among Older Adults* (Updated 11/13/2000), *The Costs of Fall Injuries Among Older Adults* (Updated 1/27/2000), and *Drowning Prevention* (Updated 10/27/2000). Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Access: www.cdc.gov/ncipc/factsheets.

CDC. 2000b. SafeUSA: A national program of injury control. Injury Control Update. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. 3(1): 1-12.

References (continued)

CDC. 2000c. Blood Lead Levels in Young Children–United States and Selected States, 1996-1999. Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report. 49(50): 1133-7.

CDC. 1997. Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials. Centers for Disease Control and Prevention. Atlanta.

Clickner, R.P., Marker, D., Viet, S.M., Rogers, J., Broene, P. 2001. National Survey of Lead and Allergens in Housing. Volume I: Analysis of Lead Hazards, Final Draft. Prepared for: U.S. Department of Housing and Urban Development (HUD).

Clifford, P.K. and D.J. Siu. 1998. Performance Testing of Residential CO Detectors. Prepared for Gas Research Institute, Chicago, IL.

Cohen , L.R., Sheaffer, L.G., Gordon, A.N. et al. 1996. Child Development Healths, and Safety: Educational Materials for Home Visitors and Parents. Aspen Publishers, Inc. Gaithersburg, MD.

Conley, C.J. and R.F. Fahy. 1994. Who dies in fires in the United States? NFPA Journal. May/June 1994.

Cumming, R.G., Thomas, M., Szonyi, G., Salkeld, G., O'Neill, E., Westbury, C., and Frampton, G. 1999. Home visits by an occupational therapist for assessment and modification of environmental hazards: A randomized trial of falls prevention. J Am Geriatrics Society. 47(12): 1397-1402.

DiGuiseppi, C. and I.G. Roberts. 2000. Individual-level injury prevention strategies in the clinical setting. The future of children: Unintentional Injuries in Childhood. 10(1): 53-84.

The Doc4Kids Project. 1998. Not safe at home: How America's housing crisis threatens the health of its children. February, 1998. Boston Medical Center and Children's Hospital, Boston, MA. Available at: http://www.bmc.org/program/doc4kids/index.html.

Douglas, M.R., Mallonee, S., and Istre, G.R. 1998. Comparison of community based smoke detector distribution methods in an urban community. Injury Prevention. 4:28-32.

Dowd, M.D. 1999. Childhood injury prevention at home and play. Current Opinions in Pediatrics. 11(6): 578-582.

Dowswell, T., Towner, E.M., Simpson, G., and Jarvis, S.N. 1996. Preventing childhood unintentional injuries - what works? A literature review. Injury Prevention. 2(2): 140-149.

Fahy, R.F. and A.L. Norton. 1989. How Being Poor Affects Fire Risk…. Fire Journal. January/February 1989: 28-36.

Gallagher, S., Hunter, P., and Guyer, B. 1985. A home injury prevention program for children. Pediatric clinics of North America. 32(1): 95-112.

References (continued)

Garrett, M.H., Hooper, M.A., Hooper, B.M., and Abramson, M.J. 1998. Respiratory symptoms in children and indoor exposure to nitrogen dioxide and gas stoves. American J. Respiratory and Critical Care Medicine. 158: 891-895.

Galke, W., Clark, S., Wilson, J., Jacobs, D., Succop, P., Dixon, S., Bornschein, B., McLaine, P., and Mei Chen. 2001. Evaluation of the HUD Lead Hazard Control Grant Program: Early Overall Findings. Environmental Research. 86(2): 149-156.

Glik, D.C., Greaves, P.E., Kronenfeld, J.J., and Jackson, K.L. 1993. Safety hazards in households with young children. J Pediatric Psychology. 18(1): 115-131.

Hall, J.R., Jr. 1997. Patterns of Fire Casualties in Home Fires by Age and Sex, 1990-94. Fire Analysis and Research Division, National Fire Protection Association.

International Approval Services (IAS). U.S. Requirements for Carbon Monoxide Alarms for Residential Use, Second Edition, June 1, 1998, No. 6-96, International Approval Services - U.S., Cleveland, Ohio.

Katcher, M.L. Preliminary HUD Healthy Homes Initiative Report: Unintentional Injury (including fire) Prevention Section. [Review of data from various sources, including: the National Center for Health Statistics, the Centers for Disease Control and Prevention / *Morbidity and Mortality Weekly Reports*, the National Fire Protection Association, and Rice, D.P., et al. 1989. *Cost of Injury in the United States: A report to Congress.* Institute for Health & Aging, University of California and Injury Prevention Center, The John Hopkins University.]

Kay, R.L. and S.P. Baker. 2000. Let's emphasize fire sprinklers as an injury prevention technology. Injury Prevention. 6(1): 72-73.

Lanphear, B.P., Dietrich, K., Auinger, P. and C. Cox. 2000. Cognitive deficits associated with lood lead concentration <10 μg/dL in U.S. children and adolescents. Public Health Reports. 115(6): 530-1.

Lowry, S. 1990. Accidents at home. British Medical J. 300: 104-106.

Mallonee, S., Istre, G.R., Rosenberg, M., Reddish-Douglas, M., Jordan, F., Silverstein, P. et al. 1996. Surveillance and prevention of residential-fire injuries. New England J. Medicine. 335: 27-31.

Marshall, S.W., Runyan, C.W., Bangdiwala, S.I., Linzer, M.A., Sacks, J.J., and Butts, J.D. 1998. Fatal residential fires: Who dies and who survives? J American Medical Association. 279(20): 1633-1637.

McCaig, L.F. and C.W. Burt. 2001. National Hospital Ambulatory Medical Care Survey: 1999 Emergency Department Summary. *Advance Data from Vital Health and Statistics,* Number 320, June 25, 2001. National Center for Health Statistics, Division of Health Care Statistics.

References (continued)

NAS. 2000. Clearing the Air: Asthma and Indoor Exposures. National Academy of Sciences, Institute of Medicine, Division of Health Promotion and Disease Prevention. National Academy Press, Washington, D.C. 438 pp.

NSC. 2002. Personal communication with Kevin Fearn, National Safety Council, Research and Statistics Department, regarding NSC analysis of NCHS 1998 National Vital Statistics System Mortality data and age group-specific information. January 24, 2002.

NSC. 2001. Injury Facts 2001 edition. National Safety Council, Research and Statistics Department. Itasca, IL

NSC. 2000. Injury Facts 2000 edition. National Safety Council, Research and Statistics Department. Itasca, IL.

NSC. 1994. Accident Facts 1994 edition. National Safety Council, Research and Statistics Department. Itasca, IL.

Quinlan, K.P., Sacks, J.J. and M. Kresnow. 1998. Exposure to and Compliance with Pediatric Injury Prevention Counseling – United States, 1994. Pediatrics. 102(5).

Runyan, C.W., Bangdiwala, S.I., Linzer, M.A., Sacks, J.J., and J.B. Butts. 1992. Risk Factors for Fatal Residential Fires. N Engl J Med. 327: 859-63.

Santer, L.J. and Stocking, C.B. 1991. Safety practices and living conditions of low-income urban families. Pediatrics. 88(6): 1112-1118.

Schieber, R.A., Gilchrist, J., and Sleet, D.A. 2000. Legislative and regulatory strategies to reduce childhood unintentional injuries. The Future of Children. 10(1): 111-136.

Scholer, S.J., Hickson, G.B., and Ray, W.A. 1999. Sociodemographic factors identify US infants at high risk of injury mortality. Pediatrics. 103: 1183-1188.

Schwarz, D.F., Grisso, J.A., Miles, C., Homes, J.H., and Sutton, H.L. 1993. An injury prevention program in an urban African-American community. American J Public Health. 83: 675-680.

Stone, K.E., Lanphear, B.P, Pomerantz, W.J., and Khoury, J. 2000. Childhood injuries and deaths due to falls from windows. J. Urban Health. 77(1): 26-33.

Underwriters Laboratory, Inc., UL 2034 Standard for Single and Multiple Station Carbon Monoxide Alarms, Third Edition, October, 1997, Northbrook, IL.

U.S. Census Bureau, postcensal estimates for 1998. United States Department of Commerce. Available on line via WONDER at http://wonder.cdc.gov/ or at the U.S. Census Bureau website at http://www.census.gov/

USDHHS. 1990. Childhood Injuries in the United States. U.S. Department of Health and Human Services, Centers for Disease Control, Center for Environmental Health and Injury Control, Division of Injury Control. Atlanta, Ga. November 1990.

References (continued)

USDHHS. 2000. Working to Prevent and Control Injury in the United States: Fact Book for the Year 2000. U.S. Department of Health and Human Services, Centers for Disease Control, Center for Environmental Health and Injury Control, Division of Injury Prevention and Control. Atlanta, Ga.

USEPA. 2001. Lead; identification of dangerous levels of lead. Final Rule. 40 CFR Part 745. Federal Register. 66(4): 1205-1240, Washington D.C., U.S. Environmental Protection Agency, January 5, 2001.

USEPA. 2000. Air Quality Criteria for Carbon Monoxide. U.S. Environmental Protection Agency, National Center for Environmental Assessment. June, 2000. EPA 600/p-99/00/F.

USEPA. 1998. Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil, Volume I. (EPA 747_R-97-006). June, 1998.

USEPA. 1998b. Review of Studies Addressing Lead Abatement Effectiveness: Updated Edition, EPA 747-B-98-001, December 1998.

USEPA. 1992. Indoor Air Quality and New Carpet. (Fact sheet). U.S. Environmental Protection Agency. Washington, D.C. (EPA/560/2-91-03).

Warda, L., Tenenbein, M., and Moffatt, M.E.K. 1999. House fire injury prevention update: Part II. A review of the effectiveness of preventive interventions. Injury Prevention. 5: 217-225.

Wintemute, G.J. 1990. Childhood drowning and near-drowning in the United States. American J of Diseases of Children. 144: 663-669.

Appendix A. Additional Internet Resources

In addition to the references and links appearing in the reference list above, the following table provides selected links with additional information on injury and associated issues.

Sponsoring Organization/Topic	Internet Web Site Address
American Academy of Pediatrics – The Injury Prevention Program (TIPP)	http://www.aap.org/family/tippmain.htm
American Association of Poison Control Centers	http://www.aapcc.org/
American Public Health Association	http://www.apha.org/
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.	http://www.ashrae.org/
Boston Medical Center Doc4Kids Program	http://www.bmc.org/program/doc4kids/index.html
Canada Mortgage and Housing Corporation (Healthy Housing & Sustainability Projects)	http://www.cmhc-schl.gc.ca/cmhc.html (http://www.cmhc-schl.gc.ca/en/imquaf/hehosu/index.cfm)
Carbon Monoxide Headquarters	http://www.coheadquarters.com/CO1.htm
CDC's Childhood Lead Poisoning Prevention Program	http://www.cdc.gov/nceh/lead/lead.htm
CDC's National Center for Injury Prevention and Control	http://www.cdc.gov/ncipc
CDC's Web-based Injury Statistics Query and Reporting System (WISQARS ™)	http://www.cdc.gov/ncipc/wisqars/
CDC's Preventing Falls Among Seniors Page	http://www.cdc.gov/ncipc/duip/spotlite/falls.htm
CDC's Wide-ranging Online Data for Epidemiological Research (WONDER)	http://wonder.cdc.gov/
Center for Injury Research & Control, University of Pittsburgh	http://www.circl.pitt.edu/home/
Children's Environmental Health Network	http://www.cehn.org/
Children's Health Environmental Coalition Network	http://www.checnet.org
Children's Safety Network: National Injury and Violence Prevention Center	http://www.edc.org/HHD/csn/
Consumer Products Safety Commission (CPSC)	http://www.cpsc.gov/
Environmental Health Watch	http://www.ehw.org/
Gas Technology Institute (information on carbon monoxide)	http://www.gri.org/
Harborview Injury Prevention and Research Center	http://depts.washington.edu/hiprc/
Harvard Injury Control Research Center	http://www.hsph.harvard.edu/hicrc/index.html
Health House Project of the American Lung Association	http://www.healthhouse.org/
HUD's Healthy Homes for Healthy Children	http://www.hud.gov/consumer/hhhchild.cfm
HUD's Office of Healthy Homes and Lead Hazard Control	http://www.hud.gov/offices/lead/
Injury Control Resource Information Network (Center for Injury Research & Control)	http://www.injurycontrol.com/icrin/index.html
Injury Free Coalition for Kids	http://www.injuryfree.org/
The Injury Prevention Web (Internet Injury Prevention Resources)	http://www.injuryprevention.org/ (http://www.injuryprevention.org/links/links.htm)
Loews Home Safety Council	http://www.loweshomesafety.org/

Sponsoring Organization/Topic	Internet Web Site Address
Minnesota Department of Health Children's Environmental Health	http://www.health.state.mn.us/divs/eh/children/index.html
National Center for Lead Safe Housing	http://www.centerforhealthyhousing.org/
National Resource Center on Supportive Housing and Home Modification for the elderly	http://www.homemods.org/index.html
National Fire Protection Association	http://www.nfpa.org/
National SAFE KIDS Campaign	http://www.safekids.org
National Safety Council Environmental Health Center	http://www.nsc.org/ehc.htm
National Safety Council Home Safety	http://www.nsc.org/home/homesafe.htm
National Safety Council Indoor Air Program	http://www.nsc.org/ehc/indoor/iaq.htm
New Jersey Poison Information and Education System	http://www.njpies.org
NIH National Institute for Child Health and Human Development	http://www.nichd.nih.gov
Occupational Safety and Health Administration (information on carbon monoxide)	http://www.osha-slc.gov/SLTC/healthguidelines/carbonmonoxide/index.html
Poison Prevention Week Council	http://www.poisonprevention.org/index.html
SafeUSA Program of the CDC	http://www.cdc.gov/safeusa/
Safer Child, Inc. – Indoor Pollution and Home Safety	http://www.saferchild.org/indoor.htm
Society for Public Health Education	http://www.sophe.org/Unintentional-Injury/index.html
The Johns Hopkins Center for Injury Research & Policy	http://www.jhsph.edu/Research/Centers/CIRP/
U.S. Consumer Product Safety Commission	http://cpsc.gov/
USDA - HUD Healthy Home Partnership	http://www.uwex.edu/healthyhome/
USEPA Indoor Air Quality Home Page	http://www.epa.gov/iaq/
USEPA Office of Children's Health Protection	http://www.epa.gov/children/
U.S. Fire Administration	http://www.usfa.fema.gov/